

**Title: Role of Calcium and Iron in SO<sub>3</sub> Formation in Coal-Fired Power Plants: Laboratory and Field Studies**

**Authors:** Constance L. Senior  
senior@psicorp.com  
Lawrence E. Bool III  
Shin G. Kang  
telephone: 978.689.0003  
fax: 978.689.3232  
Physical Sciences Inc.  
20 New England Business Center  
Andover, MA 01810

Stephen A. Johnson  
stevej47@worldnet.att.net  
telephone: 603.425.6765  
ADA Environmental Solutions  
30 Hickory Lane  
Windham, NH 03087

**Summary**

Mineral matter in coal plays an important role in the emissions of sulfur dioxide and particulate matter. Iron oxide in ash can act as a catalyst for the oxidation of SO<sub>2</sub> to SO<sub>3</sub>, resulting in better performance of an electrostatic precipitator and thus lower particulate emissions. Calcium in ash can react with SO<sub>2</sub> (and SO<sub>3</sub>) to give a lower level of sulfur emissions than predicted from analysis of the coal. Reaction of calcium in fly ash could also remove SO<sub>3</sub> from the flue gas. This latter effect could impact flue gas conditioning by addition of SO<sub>3</sub>, effectively neutralizing the conditioning. Physical Sciences Inc. (PSI) has carried out laboratory experiments and field testing to develop a better understanding of the fate of sulfur during coal combustion. The end result of this effort has been the development of a software package, Compliance Advisor<sup>TM</sup>, which predicts the effect of coal composition on slagging, SO<sub>2</sub> emissions, and particulate emissions from coal-fired power plants.

Laboratory studies have determined the relevant temperature range for reaction of gaseous SO<sub>2</sub> with flyash as well as the temperature range for oxidation of SO<sub>2</sub> to SO<sub>3</sub> by iron-containing materials. These laboratory results have been validated by field testing at two full-scale boilers. Field testing has also revealed the importance of ash deposits in the convective pass in determining both the SO<sub>2</sub> and SO<sub>3</sub> concentrations in the flue gas.